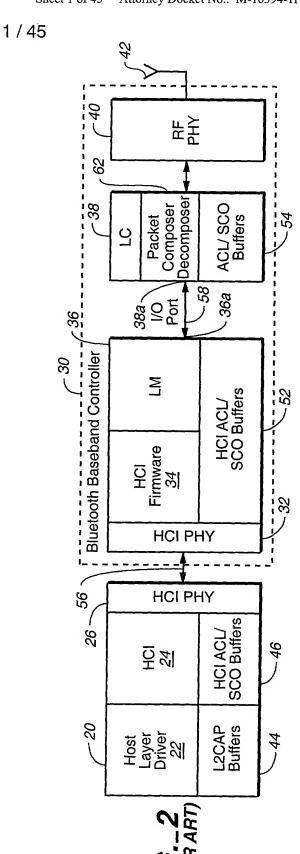


U.S. Patent Application Serial No. 10/052,877 Inventors: MIN-SHIN MA and ALLAN JON FLIPPIN For: BLUETOOTH BASEBAND CONTROLLER Sheet 1 of 45 Attorney Docket No.: M-10394-1P US





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	0							0				
		Connection Handle	Data Byte 0						Connection Handle	Data Byte 1		
	2'8	Connectic	yte 1					2'8	Connection			
ta Packet	15	BC PB	Data Byte 1				ıta Packet	16,15	Reserved	•••		
HCI ACL Data Packet	24,23 16,15	Data Total Length	••				HCI SCO Data Packet	24, 23	Data Total Length			
	31 24	Data To						31	Data Byte 0			
	_	.	FIG. 34	(PRIOR ART)	اا			_		FIG. 3B	(PRIOR ART)	•



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Data Flow and Buffer Scheme in the Bluetooth Host Controller

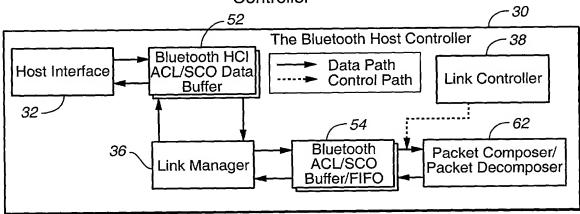


FIG._4 (PRIOR ART)

Dual Buffer Scheme For ACL Packet Transmission

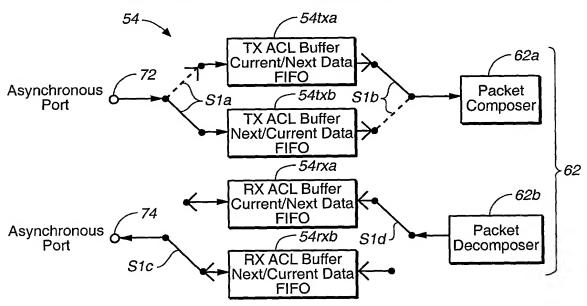


FIG._5A (PRIOR ART)

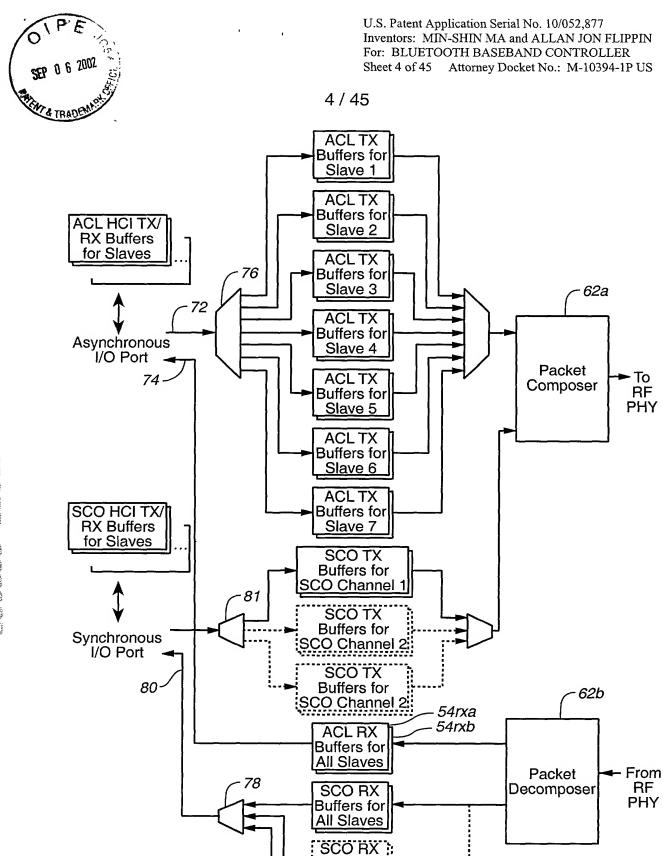


FIG._5B (PRIOR ART)

Buffers for All Slaves

SCO RX Buffers for All Slaves



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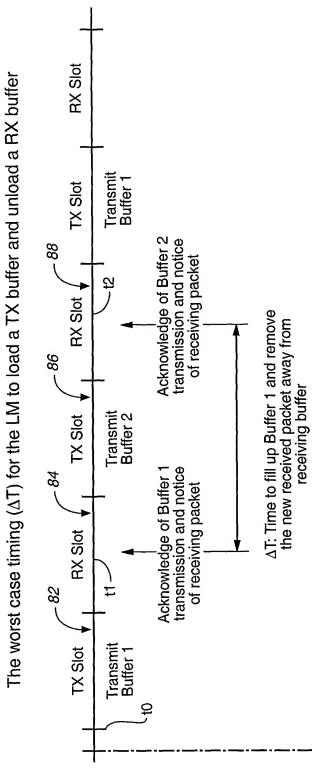
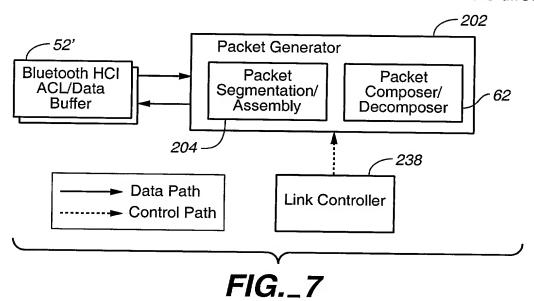


FIG._6 (PRIOR ART)



The Packet Generator accesses the HCI ACL / SCO buffers directly



Bluetooth
HCI ACL
buffer/ FIFO

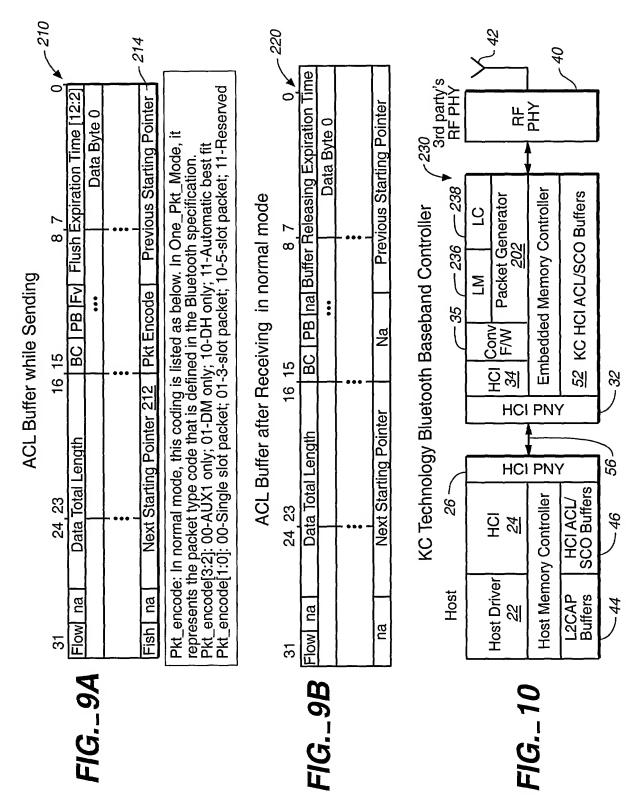
Next Starting Pointer 214

Previous Starting Pointer 212

FIG._8



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ACL transmission control flow of KC Technology's partition

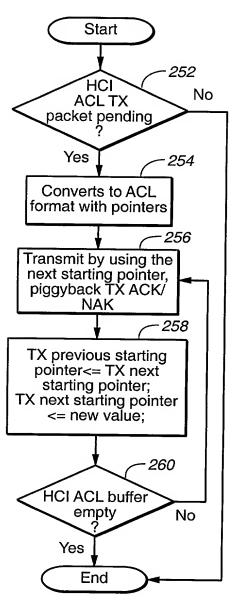


FIG._11

ACL receiving control flow of KC Technology's partition

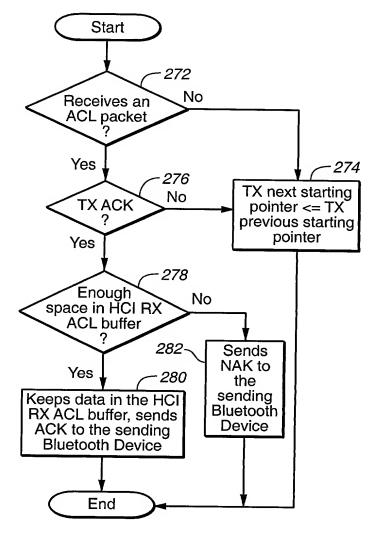


FIG._12



the gar stant man and area area, and a fine of the first facility of the facility of the first facility of the facility of the first facility of the first facility of the first

and any and per per fine from

230 RF PHY 뚪 40-238 Hardware Packet Generator ပ KC Technology's Partition between firmware and hardware 23 ≥ Bluetooth Host Controller Host Memory (HCI ACL/ SCO Buffers) 290~ Firmware 오 Firmware Physical Bus Interface 오 24, 34 -Physical Bus Interface Host Memory -2CAP Buffers) 44 _ HCI Driver Bluetooth Host TX Route: Host Driver Higher Layer Driver 22.

RF PHY 40. Packet Generator 202 Host Memory (HCI ACL/ SCO Buffers) 52 -오 24, 34-Host Memory L2CAP Buffers) 44 RX Route: Host Driver 22



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For: BLUETOOTH BASEBAND CONTROLLER
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Type A-2: Host / KC Technology Bluetooth BaseBand Controller

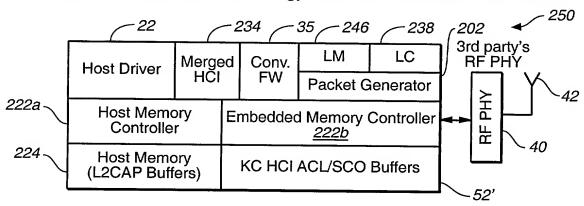


FIG._15A

Type A-2: Host / KC Technology Bluetooth BaseBand Controller

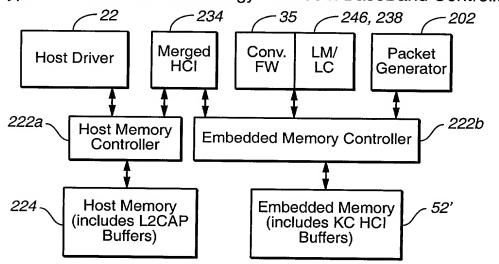
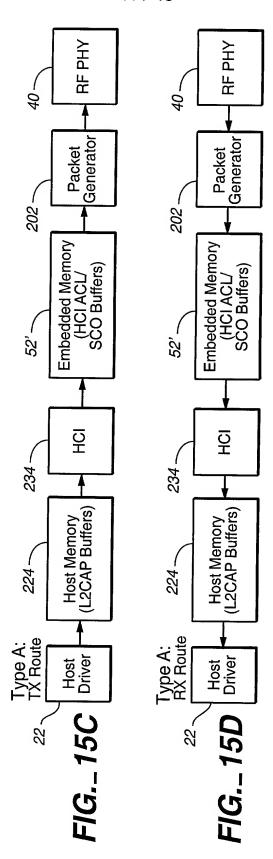


FIG._15B



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12 / 45 Type A-1: Host / Bluetooth BaseBand Controller

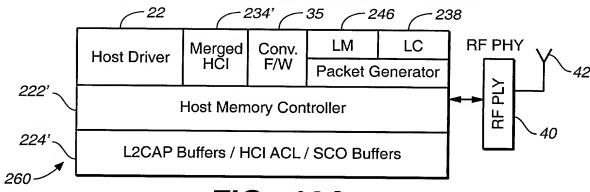


FIG._16A

TYPE A-1: Host / Bluetooth BaseBand Controller

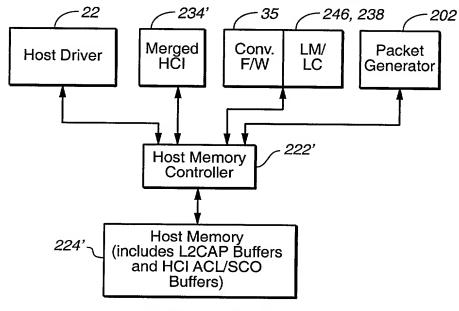


FIG._16B

Type B: Host / Bluetooth BaseBand Controller

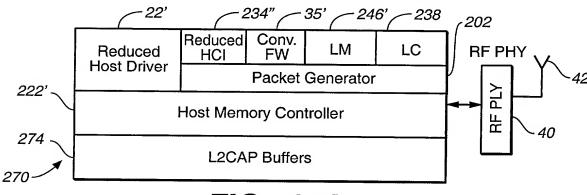
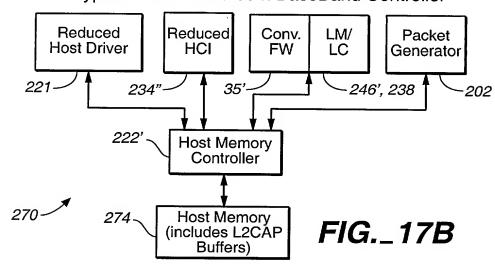


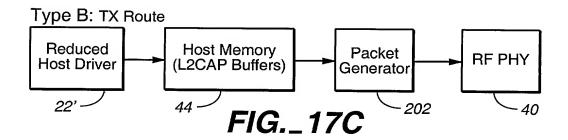
FIG._17A

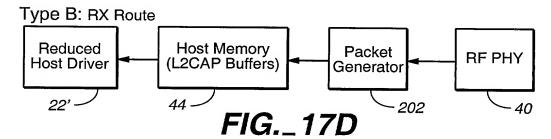


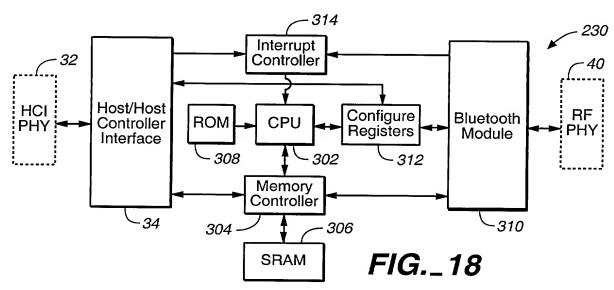
U.S. Patent Application Serial No. 10/052,877 Inventors: MIN-SHIN MA and ALLAN JON FLIPPIN For: BLUETOOTH BASEBAND CONTROLLER Sheet 13 of 45 Attorney Docket No.: M-10394-1P US

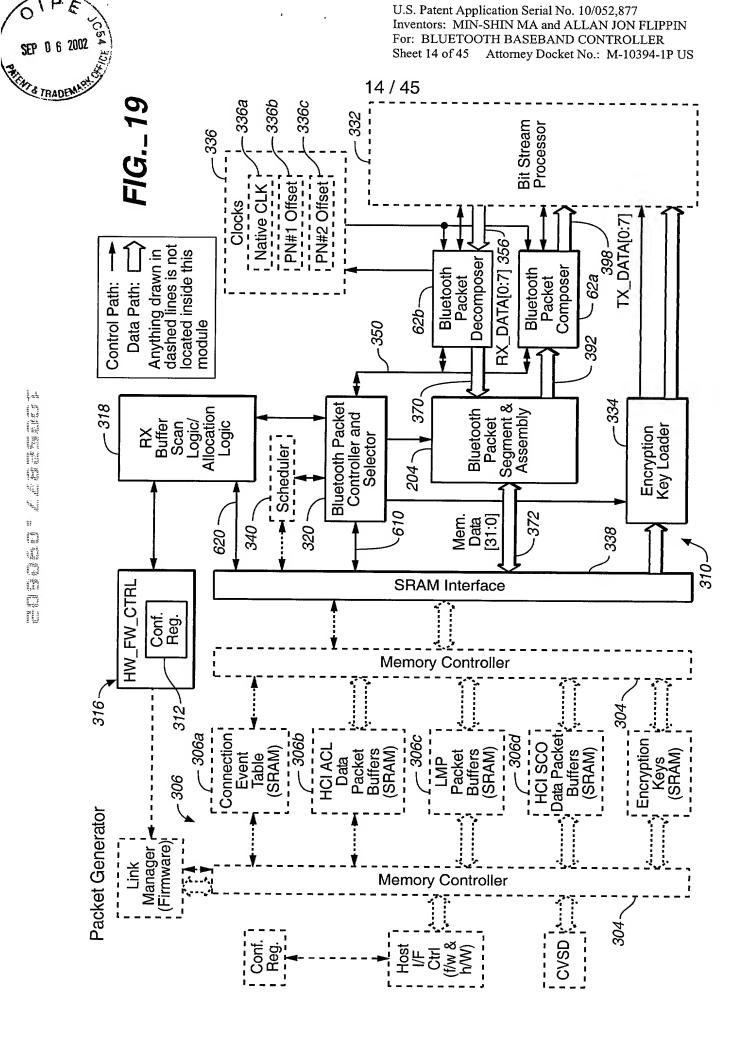
13 / 45 Type B: Host / Bluetooth BaseBand Controller













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	_					
	0	na		UAP[7:2]	23:10]	na
orage format:	7 8		LAP	:0]	CLASS[23:10]	PSM[2:0]
Outgoing FHS Packet storage format:	16 15	0 1 1 1 0 BC 0 0		NAP[15:0]	AM_ADR [2:0]	Δ.
ŏ	24,23	na	UAP SP SR [1:0] [1:0] [1:0] na	CLASS[9:0]	па	na
•	.			20) 	

	_					
nat:	0 2 8	na		UAP[7:2]	CLASS[23:10]	CLK[27:17]
Incoming FHS Packet storage format:	16 15	0 1 1 1 0 BC 0 0 1	LAP	NAP[15:0]	AM_ADR [2:0]	CLKOFFSET[16:2] na PSM[2:0]
	31 24 23	na	UAP SP SR [1:0] [1:0] [1:0]	CLASS[9:0]	CLK[16:2]	na
	31	na	UAP SP SR [1:0] [1:0] [1:0]	CLASS[9:0	CLK[16:	na

FIG._21



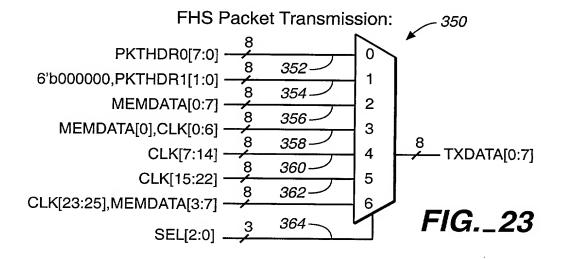
U.S. Patent Application Serial No. 10/052,877 Inventors: MIN-SHIN MA and ALLAN JON FLIPPIN For: BLUETOOTH BASEBAND CONTROLLER Sheet 16 of 45 Attorney Docket No.: M-10394-1P US

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Data Byte Sending Sequence in FHS packet:

Byte# & name	Di+O	D:+1	D:+0	D:40	DitA	Dire	D'IO	D:
1:Packet	Bit0	Bit1	Bit2	Bit3	Bit4	Bit5	Bit6	Bit7
Header 0	amadr0	amadr2	amadr2	pkttp0	pkttp1	pkttp2	pkttp3	flow
2:Packet Header 1	arqn	seqn	_	_	_	_	_	
3:FHS 0	lap0	lap1	lap2	lap3	lap4	lap5	lap6	lap7
4:FHS 1	lap8	lap9	lap10	lap11	lap12	lap13	lap14	lap15
5:FHS 2	lap16	lap17	lap18	lap19	lap20	lap21	lap22	lap23
6:FHS 3	tbd0	tbd1	sr0	sr1	sp0	sp1	uap0	uap1
7:FHS 4	uap2	uap3	uap4	uap5	uap6	uap7	nap0	nap1
8:FHS 5	nap2	nap3	nap4	nap5	nap6	nap7	nap8	nap9
9:FHS 6	nap10	nap11	nap12	nap13	nap14	nap15	clss0	clss1
10:FHS 7	clss2	clss3	clss4	clss5	clss6	clss7	clss8	clss9
11:FHS 8	clss10	clss11	clss12	clss13	clss14	clss15	clss16	clss17
12:FHS 9	clss18	clss19	clss20	clss21	clss22	clss23	amad0	amad1
13:FHS 10	amad2							
14:FHS 11								
15:FHS 12								
16:FHS 13				pgscn0	pgscn1	pgscn2	_	_

FIG._22





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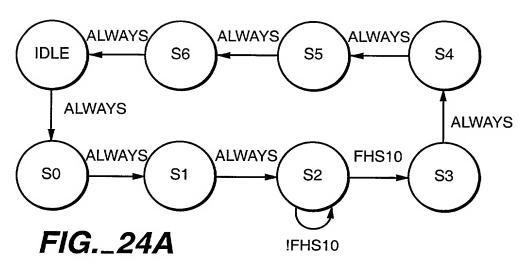


FIG._24B

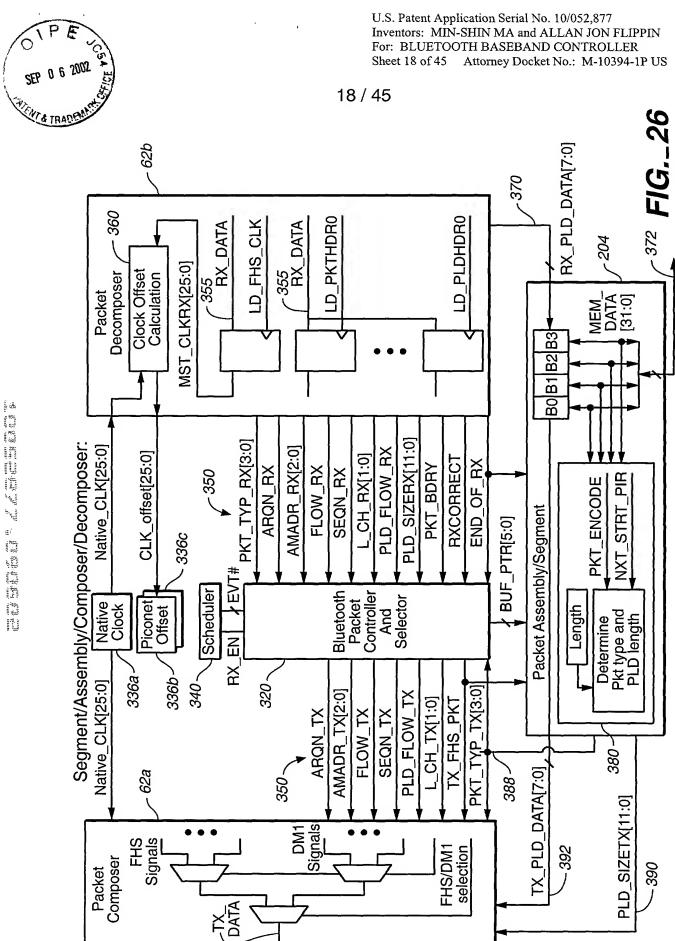
State	SEL[2:0]
IDLE	0
S0	0
S1	1
S2	2
S3	3
S4	4
S5	5
S6	6

Data Byte Sending Sequence in DM1 packet:

Bit0	Bit1	Bit2	_Bit3	Bit4	Bit5	Bit6	Bit7
amadr0	amadr1	amadr2	pkttp0	pkttp1	pkttp2	pkttp3	flow
arqn	seqn	_	_	_	_	_	_
I_ch 0	I_ch 1	pld_flow	length0	length1	length2	length3	length4
data bit 0	data bit 1	data bit 2	data bit 3	data bit 4	data bit 5	data bit 6	data bit 7
data bit 0	data bit 1	data bit 2	data bit 3	data bit 4	data bit 5	data bit 6	data bit 7
•••	•••	•••	•••	•••	•••	•••	•••
data bit 0	data bit 1	data bit 2	data bit 3	data bit 4	data bit 5	data bit 6	data bit 7

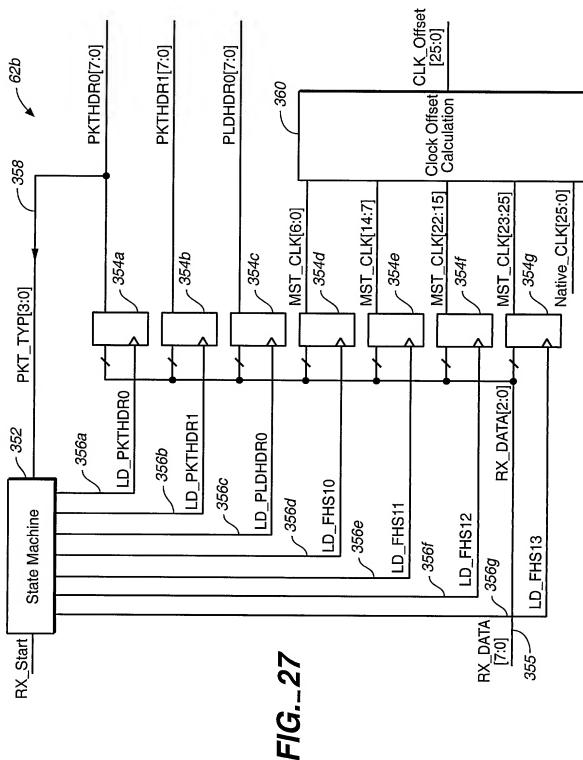
n: data length

FIG._25





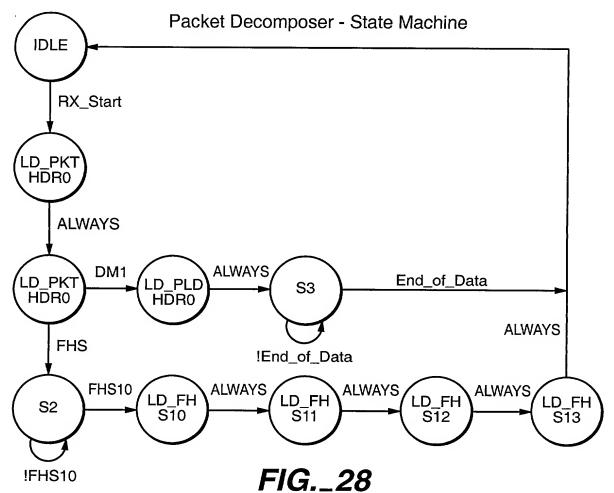
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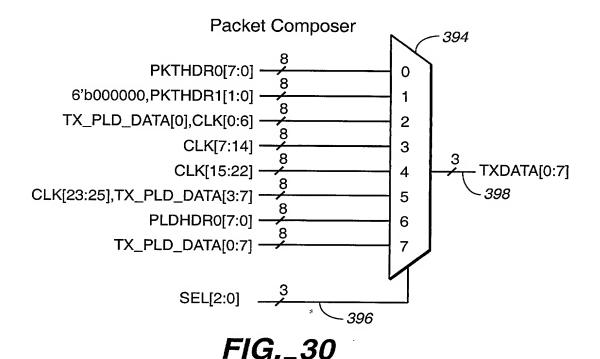




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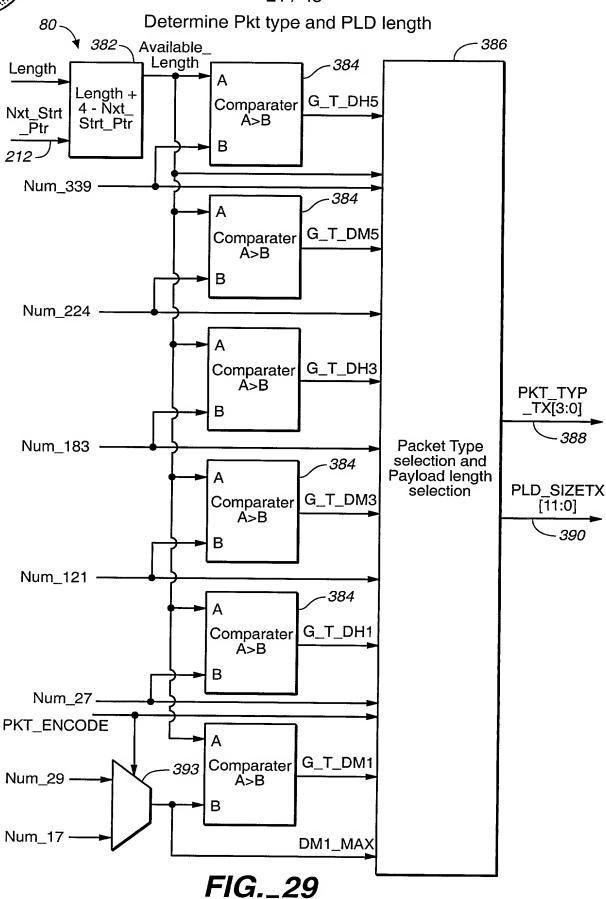


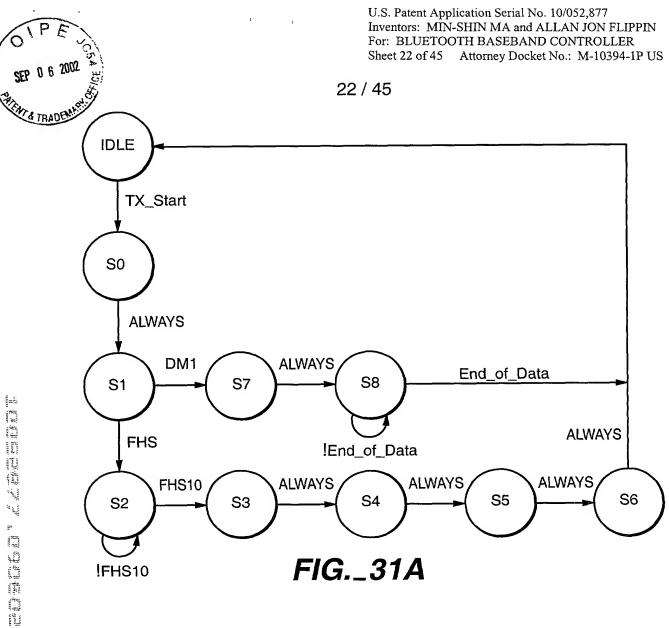
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State	SEL[2:0]
IDLE	0
S0	0
S1	1
S2	7
S3	2
S4	3
S5	4
S6	5
S7	6
S8	7

FIG._31B



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Dual pointer buffer control scheme (1)

MSB	<u>404</u>		,	400 LSB
dn tg	Pointer of ACL Out/In	dn	tg	Pointer of ACL Out/In
1 1	Buffer 1	O	O	Buffer 0

FIG._32

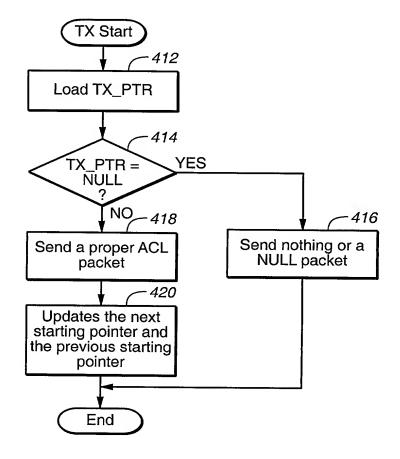


FIG._33





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How to convert between the L2CAP packet format and buffer format

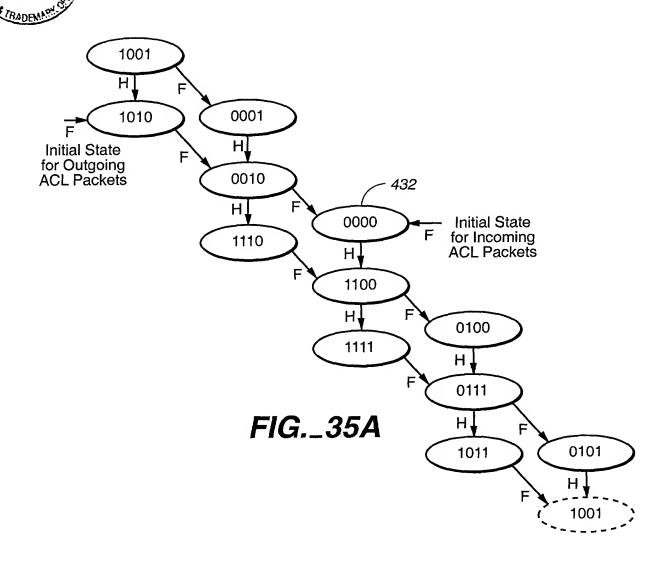
	LADAP Packet Politial				
annel ID	31 24	1,23	16, 15	80	7
	Chann	lel ID		L2CAF	Length
2 ch G				•	Data Byte 0
			••		
Doto B. do a			•		
Dala Byle II	Data Byte n	:			

How to convert between the L2CAP packet format and buffer format

Flush Expiration Time[12:2] Data Byte 0 L2CAP Length 8 7 Pkt Encode BC 16 15 Data Total Length Channel ID ACL Buffer while Sending 31 24 23 Data Byte n Flow Flsh

SEP 0 6 2002

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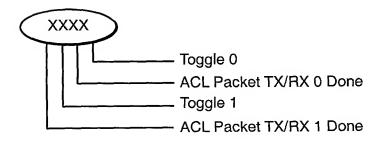
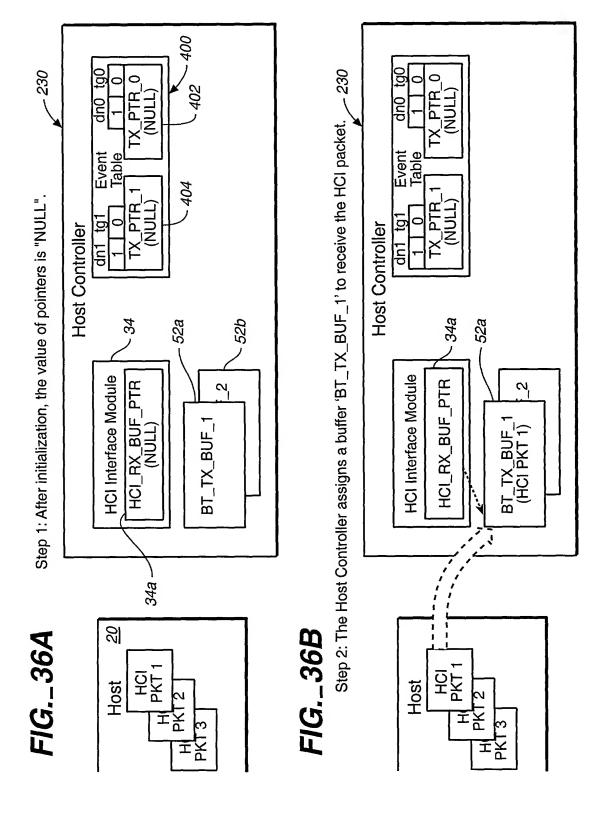


FIG._35B

SEP 0 6 2002 A

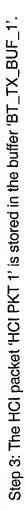
U.S. Patent Application Serial No. 10/052,877 Inventors: MIN-SHIN MA and ALLAN JON FLIPPIN For: BLUETOOTH BASEBAND CONTROLLER Sheet 26 of 45 Attorney Docket No.: M-10394-1P US



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FIG._36C



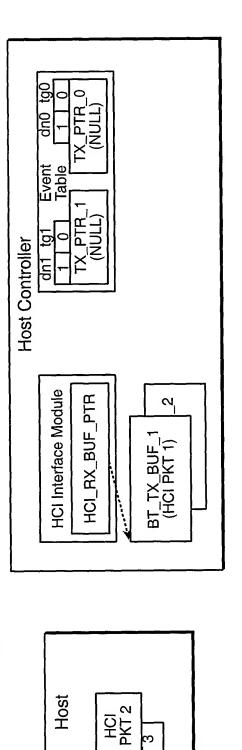
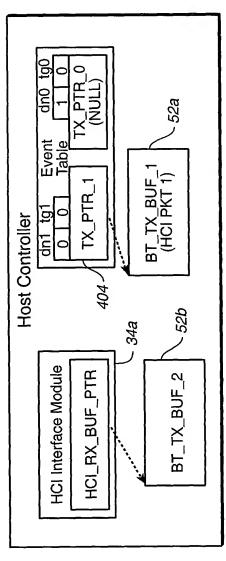
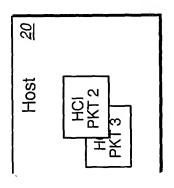


FIG._36D

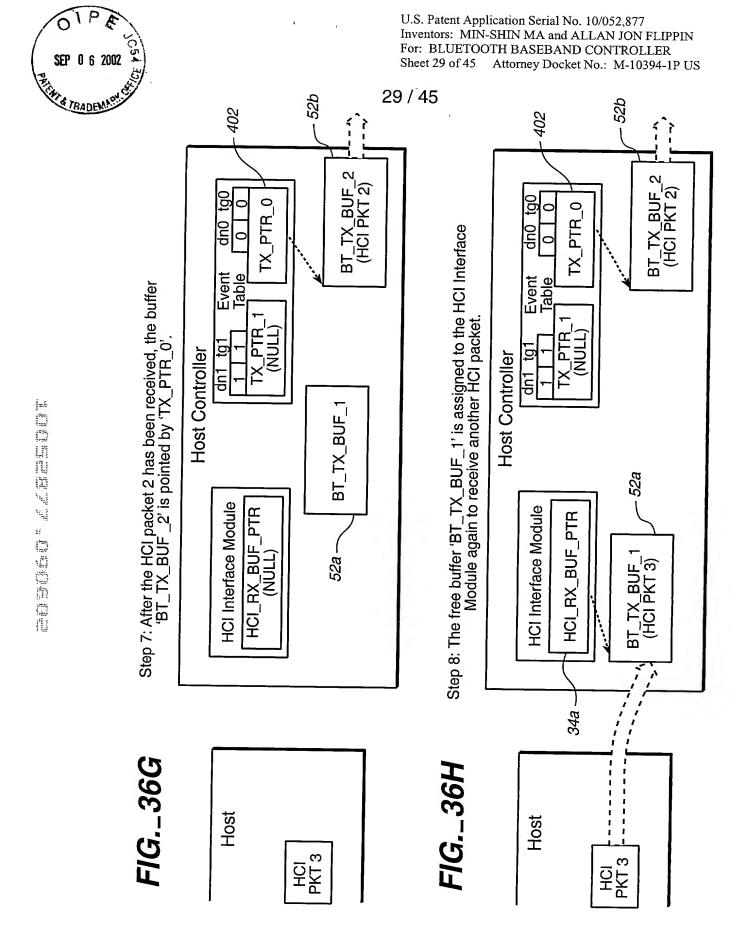
Step 4: The Host Controller assigns another buffer 'BT_TX_BUF_2' to receive the HCI packet.





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Ĭ

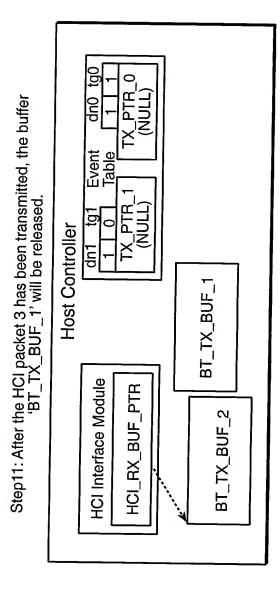


U.S. Patent Application Serial No. 10/052,877 Inventors: MIN-SHIN MA and ALLAN JON FLIPPIN For: BLUETOOTH BASEBAND CONTROLLER Attorney Docket No.: M-10394-1P US Sheet 30 of 45 30 / 45 52b 402 BT_TX_BUF_2 (HCI PKT 2) tg0 TX_PTR_0 PTR guo 0 Step 10: The free buffer 'BT_TX_BUF_2' is assigned to the HCl Interface Module again to receive another HCl packet. Step 9: Assuming that the HCI packet 3 is received before the HCI packet 2 is sent, 'TX_PTR_1'points to buffer 'BT_TX_BUF_1'. Event Table Event Table BT_TX_BUF_1 (HCI PKT 3) TTX BUF 1 (HCI PKT 3) TX_PTR_1 TX_PTR_ Host Controller Host Controller dn1 뮵 404 52a 52b 52a **HCI Interface Module** HCI Interface Module HCI_RX_BUF_PTR HCI_RX_BUF_PTR BT_TX_BUF_2 34a – FIG._36J FIG._361 Host Host



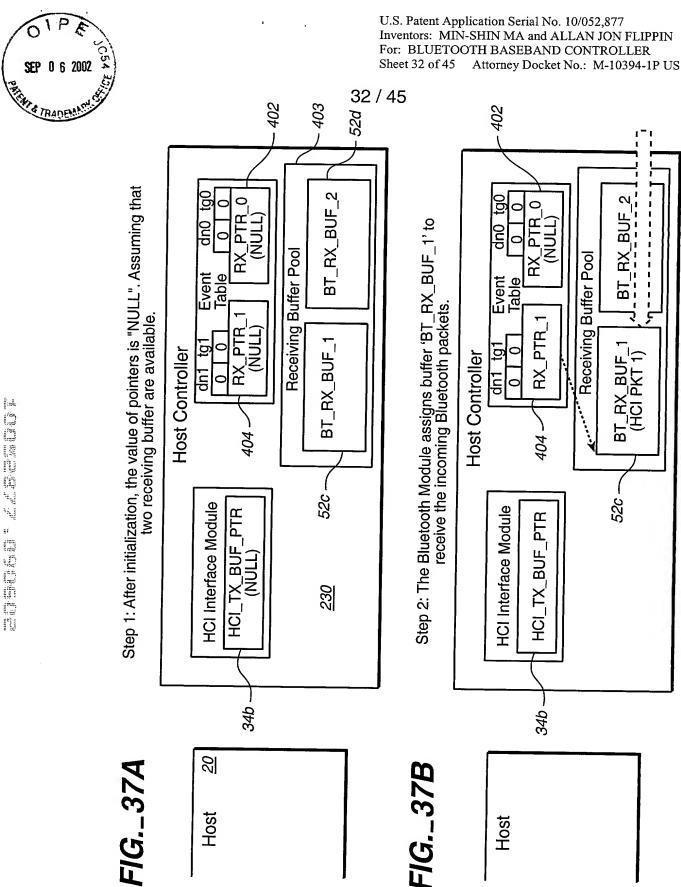
U.S. Patent Application Serial No. 10/052,877 Inventors: MIN-SHIN MA and ALLAN JON FLIPPIN For: BLUETOOTH BASEBAND CONTROLLER Sheet 31 of 45 Attorney Docket No.: M-10394-1P US

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Host





Host

Host



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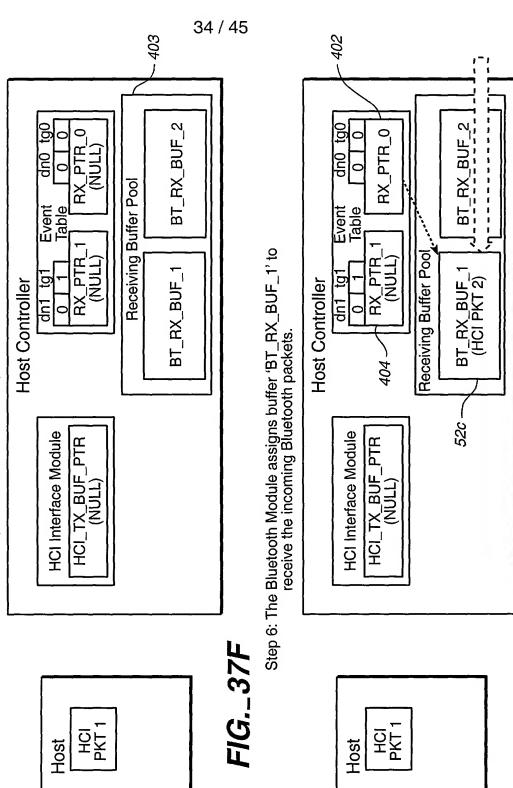
33 / 45 402 Step 4: Firmware releases this buffer 'BT_TX_BUF_1' and sends it to the HCI Interface Module. Then sets the done bit to 0. BT_RX_BUF_2 Step 3: The buffer 'BT_TX_BUF_1' is released when any one of the three buffer releasing conditions is detected. BT_RX_BUF_2 tg0 RX PTR quo Receiving Buffer Pool Receiving Buffer Pool 꿆 Event Table Event Table RX_PTR_1 HCI PKT 1) Host Controller Host Controller dn1 BT 404 52c HCI Interface Module HCI Interface Module HCI_TX_BUF_PTR HCI_TX_BUF_PTR (NULL) BT_RX_BUF_ (HCI PKT 1) 34b — 52c. FIG._37C FIG._37D 문 다 1 20 Host Host

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Inventors: MIN-SHIN MA and ALLAN JON FLIPPIN
For: BLUETOOTH BASEBAND CONTROLLER
Sheet 34 of 45 Attorney Docket No.: M-10394-1P US





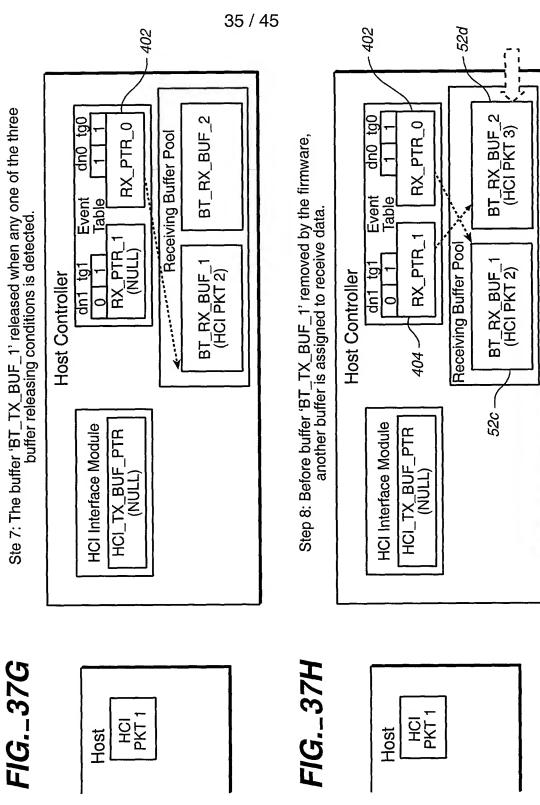




U.S. Patent Application Serial No. 10/052,877 Inventors: MIN-SHIN MA and ALLAN JON FLIPPIN For: BLUETOOTH BASEBAND CONTROLLER Sheet 35 of 45 Attorney Docket No.: M-10394-1P US

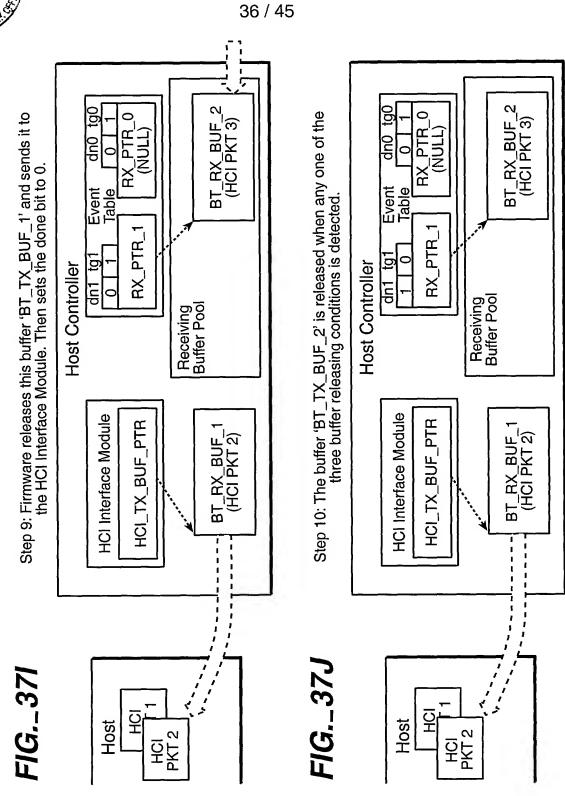


Ste 7: The buffer 'BT_TX_BUF_1' released when any one of the three buffer releasing conditions is detected.



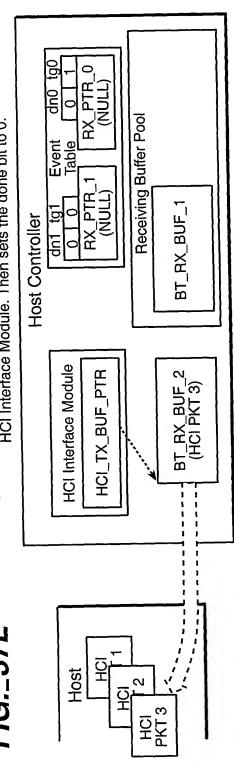
U.S. Patent Application Serial No. 10/052,877
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For: BLUETOOTH BASEBAND CONTROLLER
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Step 12: Firmware releases this buffer 'BT_TX_BUF_1' and sends it to the HCI Interface Module. Then sets the done bit to 0. ·- Receiving Buffer Pool BT_RX_BUF_2 (HCI PKT 3) Step11: After the HCl packet 1 is sent the Host, buffer 'BT_RX_BUF_1' is released and put back to the receiving buffer pool. PTR qu0 쏬 Event Table RX_PTR_1 BT_RX_BUF_1 tg1 Host Controller dn1 **HCI Interface Module** HCI_TX_BUF_PTR (NULL) FIG._37K Host FKT 2



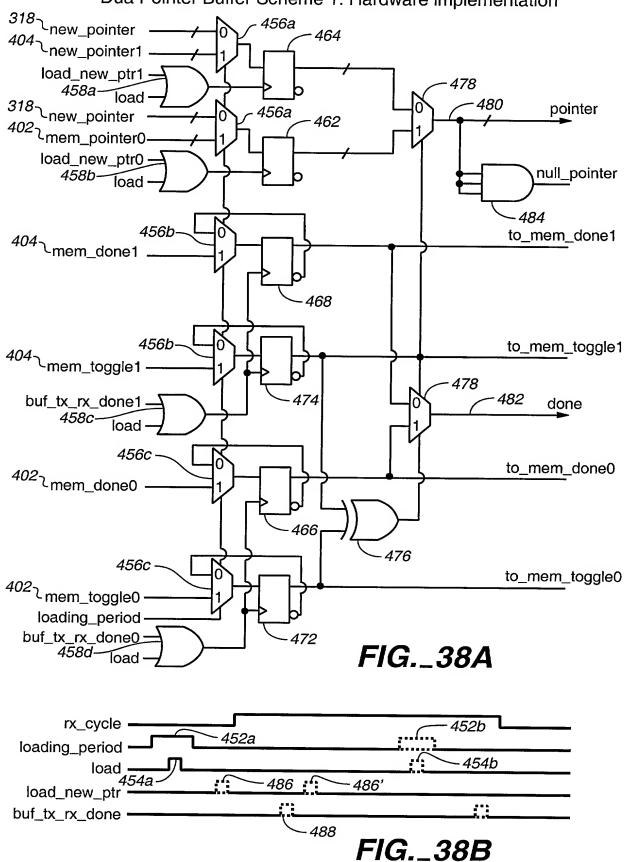
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Dua Pointer Buffer Scheme 1: Hardware implementation





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Duel Pointer Buffer Scheme 1: Firmware implementation

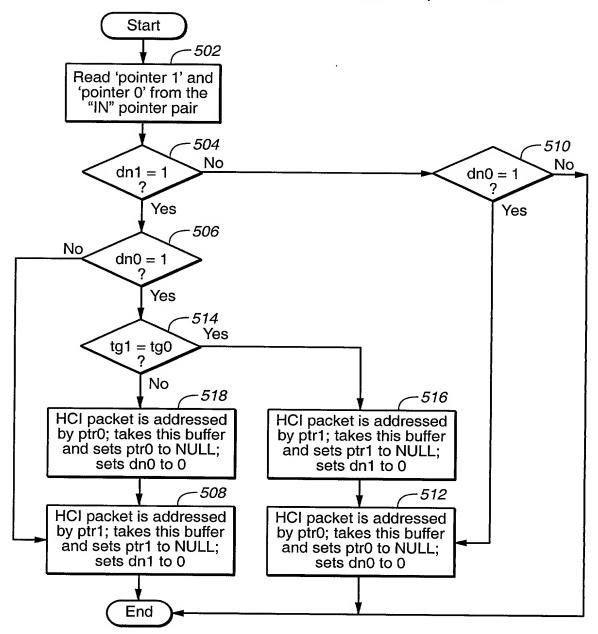


FIG._39



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Duel Pointer Buffer Scheme 1: Firmware implementation

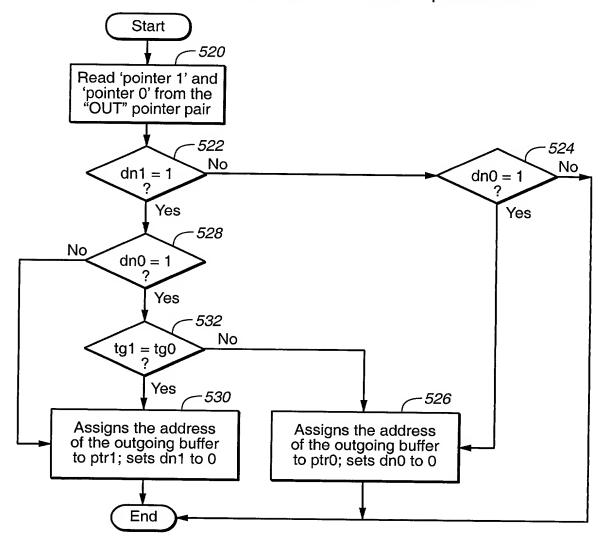


FIG._40



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Duel Pointer Buffer Scheme 1: Firmware implementation

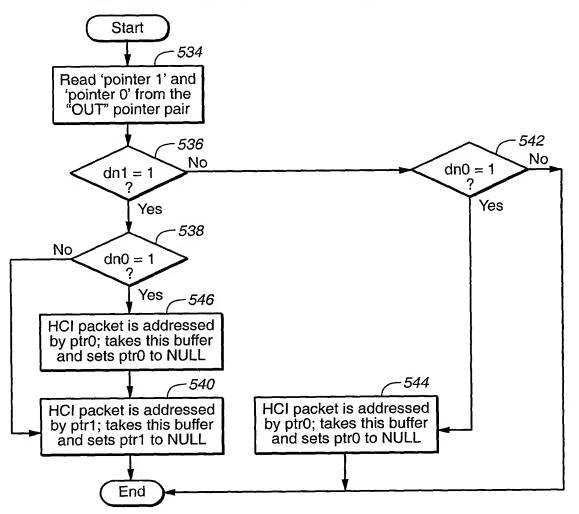
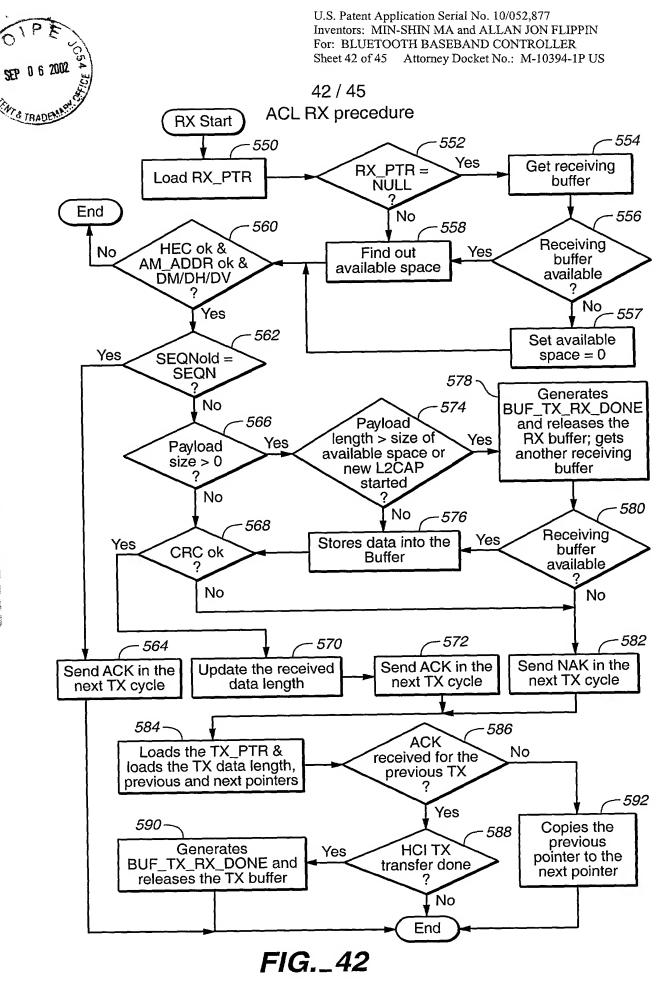
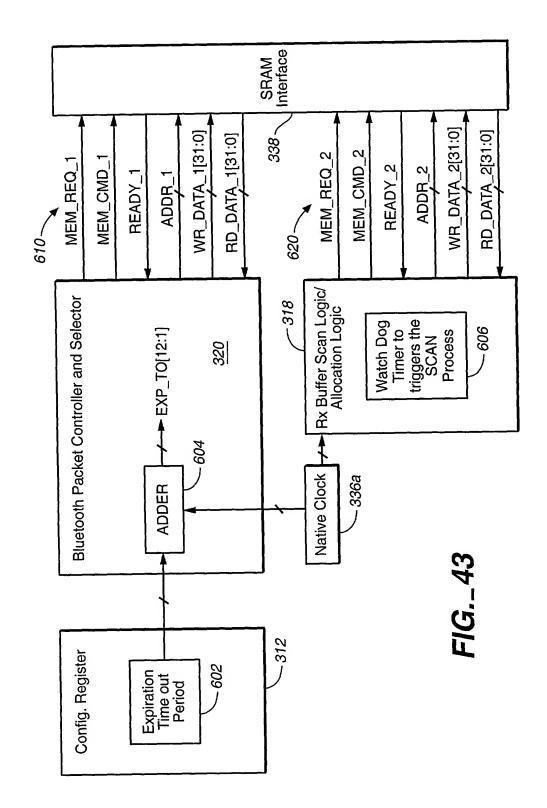


FIG._41



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ACL RX Buffer is released due to expiration time-out

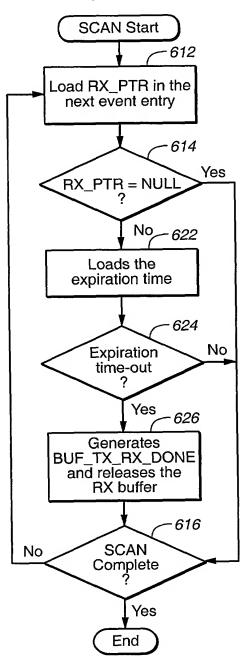
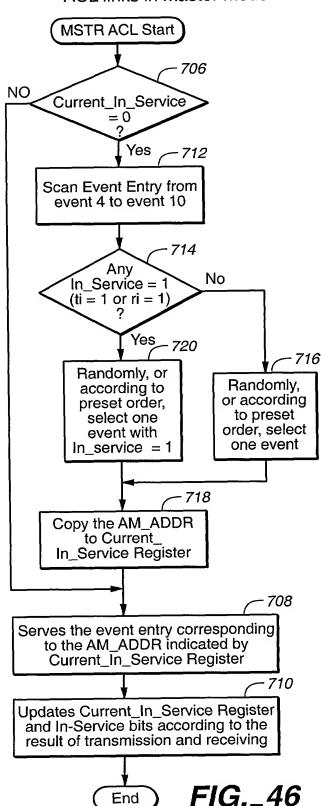


FIG._44

Scheduler - Scheduling priority of ACL links in master mode





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